

To Assess Delay Factors in Patients Undergoing for Primary Percutaneous Coronary Intervention

JAVED KHURSHED SHAIKH¹, SHAHBAZ ALI SHAIKH², MUHAMMAD HASSAN BUTT³, VICKEE KUMAR MAMTANI⁴, MUHAMMAD HASHIMKALWAR⁵, MUHAMMAD ISMAIL⁶

^{1-3,5,6}Assistant Professors, Department of Cardiology, National Institute of Cardiovascular Disease, Karachi

⁴Post Fellow Interventional Cardiology, National Institute of Cardiovascular Disease, Karachi

Correspondence to: Dr. Javed Khurshed Shaikh, Cell: 03333262171, E-mail: javedshaikhdr@gmail.com

ABSTRACT

Objective: To measure delay factors in patients undergoing primary percutaneous coronary intervention

Study Design: Cross-sectional study

Place and Duration of Study: Department of Cardiology, National Institute of Cardiovascular Disease, Karachi from 1st January 2019 to 31st July 2019.

Methodology: Ninety-seven patients of acute ST-elevation myocardial infarction of age >18 and <65 years and either gender with the indication for primary percutaneous coronary intervention were included in the study. Patients whose symptoms onset \geq 12 hours, having unstable conditions i.e. arrhythmias, cardiac arrest, severe hypertension, and indication or history for coronary artery bypass grafting were excluded.

Results: The mean age was 52.70 \pm 6.25 years and the mean duration of symptoms was 163.33 \pm 106.16 minutes. The majority of patients were males 89 (91.75%). Fifty-nine (60%) patients between 50-59 years, 23 (23.7%) between 40-49 years while 15 (15.5%) between 60-65 years. Forty-seven (48.5%) patients belonged to lower socioeconomic status. Forty (41%) patients were from urban areas, 43 (44.33%) peri-urban areas of Karachi while only 14 (14.43%) patients were referred from rural areas. The frequency of door to balloon delay (D2B delay) was found in 52 (53.6%). Misinterpretation by the patient (68%) for the symptoms and transportation delay (52.6%) were the two most common factors.

Conclusion: Pre-hospital factors (misinterpretation by the patients and first medical contact person and transportation delay) are the major factor that causes D2B delay. Other contributing factors are delay in diagnosis, unavailability of a consultant cardiologist, delay in readiness of catheterization lab, and procedure-related delays.

Keywords: Myocardial infarction, Acute ST-elevation myocardial infarction (STEMI), Primary percutaneous coronary intervention (PCI), Door to balloon delay, Coronary artery bypass grafting (CABG)

INTRODUCTION

Acute myocardial infarction (AMI) causes about 1.5 million deaths in the USA annually. In Pakistan, about 80% of adult deaths are due to myocardial infarction and other Ischemic heart diseases.¹ It has been suggested that the patients who present with the signs and symptoms of ST-elevation myocardial infarction (STEMI) within 12 hours of symptom onset and with persistent ST-segment elevation early mechanical (angioplasty) or pharmacological reperfusion should be performed.² Primary percutaneous interventions should be executed in patients with clinical and/or electrocardiographic evidence of ongoing ischemia.³

Primary PCI is defined as angioplasty and/or stenting without prior or concomitant fibrinolytic therapy, and is the preferred therapeutic option when an experienced team is available. Timing of treatment is the most crucial factor in AMI patients. Survival benefit is maximum if PCI is performed within an interval between the first medical contact (FMC) and balloon inflation (first medical contact-to-reperfusion time) of less than 120 minutes.^{2,4} Therefore PCI should be offered to STEMI patients, not only those admitted to an invasive hospital but also those patients for whom transport from a referral to an invasive hospital can be completed within 2 hours.⁵ Further the American Heart Association (AHA) guidelines⁶ recommend the interval between arrival at the hospital and intracoronary balloon inflation ("door-to-balloon" time [D2B]) to be less than 90 minutes.⁷ Door-to-balloon time, goes more than this time duration it is associated with increased mortality.²

Li Long et al⁸ studied the factors which cause D2B delay in STEMI patients. They found that median D2B time was not delayed in 73% of patients who presented directly to the PCI capable hospital while in the remaining 27% of patients who initially presented at a non PCI hospital and later transferred to the PCI hospital median D2B time was delayed ($p < 0.0001$).

Other factors which Blankenship et al⁸ found associated with delays to reperfusion included diabetes mellitus (38%), previous history of angina and congestive heart failure (37%), female gender (45%), and respiratory failure (30%). The interval from catheterization laboratory arrival to first balloon inflation was similar for transferred and non-transferred patients. Further, it was described that hospital-related delay factors like delay in diagnosis (14%), decision-making delay by the attendant (17%), delay in availability of cardiologist (14%), and delay in readiness of Cathlab comprised 48% of delayed Primary PCIs in the patient of Acute MI.⁹

MATERIALS AND METHODS

This cross-sectional study was carried out at the National Institute of Cardiovascular Diseases, Karachi from 1st January 2019 to 31st July 2019 and comprised 97 patients. Patients of age >18 and <65 years and either gender and socio-economic status, both type of presentations i.e. patient brought directly to NICVD or referred, referred from the site that is \leq 2 hours distance in a private car/taxi/ambulance, ST-elevation MI with the indication for primary PCI were included while those patients having \geq 12

hours of symptoms onset, admitted patient with a complaint of angina, unstable condition of patient i.e. arrhythmias, cardiac arrest, severe hypertension, indication for coronary artery bypass grafting, previous coronary artery by grafting done were not included. Timings of onset of symptoms, reaching to physician or hospital (NICVD emergency in case of direct reaching), mode of transport (in the ambulance or a private taxi/ car), were asked from the patient/attendant and also, the timing of the first ECG, time of availability of the cardiologist, decision time for PCI were noted. The investigator followed the patients and noted the time in which they provided consent, patient was transferred to the catheterization lab and first balloon inflation.

The data was entered and analyzed through SPSS-22. Stratification of age, gender, residence, and socioeconomic status was done to see their effect outcome variable. Assuming the P-value ≤ 0.05 was significant. Chi-square was used to detect the difference.

RESULTS

The mean age was 52.70 ± 6.25 years and the mean duration was 163.33 ± 106.16 minutes. There were 89 (91.75%) males and 8 (8.25%) females. Forty-seven (48.5%) belonged to lower socioeconomic status, 35 (36.1%) belonged to middle 15 (15.5%) belonged and higher socio-economic status patients respectively. Forty (41.24%) patients were from urban areas, 43 (44.33%) were from peri-urban areas of Karachi while only 14 (14.43%) patients were referred from rural areas. The frequency of door to balloon delay (D2B delay) was found in 52 (53.6%). It was found that misinterpretation by the patient (68%) for the symptoms and transportation delay (52.6%) were the two most common factors for delayed reaching of patients to the hospital and thus contributing to D2B delay. Other factors were; misinterpretation by the physician at FMC (35.1%), delay in providing consent/attendant time (61.9%), procedure (PCI) related delay (12.4%), diagnosis-related delay (10.3%), and delay due to readiness of catheterization lab (10.3%) [Tables 1-2].

It was seen that pre-hospital delay factors (misinterpretation by the patient, transportation delay & misinterpretation by the physician at FMC) alone were responsible for 17.9% 89% delay as compared to zero percent delay by the in-hospital factors alone. (diagnosis-related delay, procedure PCI) related delay, and delay due to readiness of catheterization lab). Cumulatively both major categories of delay factors were responsible for about 70% of delayed primary PCIs ($P < 0.001$). When the effect modification of door to balloon delay was analyzed it was observed that the elder the age of the patient, the more was the frequency of door to balloon delay. Among age patients of the age of 60 years and above it was 60% which reduced to 59.3% among patients of 50-59 years age and further decreased to 34.8% among 40-49 years aged patients ($P = 0.117$). It was noted that door to balloon delay was significantly more frequent in the female gender than the male gender (62.5% versus 52.8%) ($P = 0.027$). Socio-economic status was also found to be a significant effect modifier for the frequency of door to balloon delay ($P = 0.006$). Among low socioeconomic status patients, D2B delay was 66% ($n = 31$), among middle socio-economic

status patients D2B delay was 51.4% ($n = 18$) and among higher socio-economic status patients D2B delay was 20% ($n = 3$). Effect of residence of patients was also analyzed and it was found to be a highly significant effect modifier of ($P < 0.001$). Accordingly; those who belonged to the rural area had a higher frequency of door to balloon delay (85.7%) as compared to those who were from peri-urban areas (62.8%) and urban areas (32.5%) [Table 3].

Table 1: Demographic information of the patients (n=97)

Variable	No.	%
Age (years)		
40-49	23	23.7
50-59	59	60.8
≥ 60	15	15.5
Gender		
Male	8	8.24
Female	89	91.75
Residence		
Urban	40	41.24
Peri-urban	43	44.33
Rural	14	14.43
Socioeconomic status		
Low	47	48.5
Middle	35	36.1
Higher	15	15.5
D2B delay		
Yes	52	53.6
No	45	46.4

Table 2: Frequency of factors leading to the door to balloon delay (D2B delay) among all patients (n = 97)

Factors	No.	%
Misinterpretation by the Patient	66	68
Misinterpretation by the Physician at FMC	34	35.1
Transportation delay	51	52.6
Diagnosis-related delay	10	10.3
Delay in providing consent/ attendant time	60	61.9
Delay due to unavailability of consultant cardiologist	5	5.2
Delay due to readiness of Cath lab	10	10.3
Procedure-related delay	12	12.4

Table 3: Contribution of major delay factors in the door to balloon delay (D2B delay) in patients on whom PCI was performed with a delay

Variable	D2B delay		P-value
	Yes	No	
Factors			
Only pre-hospital	5(17.9%)	23(82.1%)	<0.001
Hospital related	-	2(100.0%)	
Both pre-hospital & hospital related	47(70.1%)	20(29.9%)	
Age (years)			
40-49	8(34.8%)	15(65.2%)	0.117
50-59	35(59.3%)	24(40.7%)	
≥ 60	9(60%)	6(40%)	
Gender			
Male	47(52.8%)	42(47.2%)	0.027
Female	5(62.5%)	3(37.5%)	
Residence			
Urban	13(32.5%)	27(67.5%)	< 0.001
Peri-urban	27(62.8%)	16(37.2%)	
Rural	12(85.7%)	2(14.3%)	

DISCUSSION

Keeping all such issues in front the current study was designed and executed to study the factors and frequency of time delays to which the acute STEMI patients come across when they are referred for primary PCI. This study is the first of its kind to be done in Pakistan. The mean age was 52.70 ± 6.25 years. Most of these patients were between the ages of 50-59 years. This age pattern of MI patients is noted among most of the studies conducted on MI patients in Pakistan as well as in other countries. Though some studies have documented MI in younger age patients those studies do not correspond to the current study in design or the objectives.^{10,11} Among patients who were eligible for primary PCI and were managed with it, delay (>120 minutes from the onset of the first symptom to inflation of the balloon in catheterization lab) was found in 52 (53.6%). This proportion of delay is alarmingly high. Meantime taken from symptoms onset to inflation of the balloon in catheterization lab in our study was 163.33 ± 106.16 minutes. Other studies found that D2B delay among their patients ranged from 14% to 69%.^{12,13} These studies documented that time from symptoms onset to inflation of balloon ranged from 20 minutes to 313 minutes. Thus, our results are in the range of prevalence of delays that the other previous studies documented.

Misinterpretation by the physician at FMC was 35.1%. This shows that more than one-third of our general practitioners either cannot instantly identify the sign symptoms of MI or they don't have ECG facilities at their clinics through which they can quickly diagnose the condition and refer the patients to a proper tertiary care facility for thrombolysis. Overall, in the current study, this delay was about 20-30 minutes but in some cases, this delay was more than 60 minutes which is quite an astonishing finding. Other studies have also documented the deficiency of knowledge and attitude of primary care physicians regarding signs and symptoms of myocardial infarction in local settings.^{12,13} Misinterpretation by the patient/ family was 68%, while transportation delay was 52.6%. These two factors were most frequently responsible for delayed reaching of patients to the PCI enable hospital. Although the majority of our patients were living in urban or peri-urban areas, still the high frequency of delay which contributed to D2B delay is a matter of concern. A bad condition of roads and traffic jams in Karachi might be potential and common contributing factors to pre-hospital transportation delay. It was interesting to note that transportation delay among patients of rural residence was highly significantly more than those patients who lived in peri-urban and urban areas ($P < 0.001$) which were thought to be due to distance from the hospital and/ or unavailability of the vehicle/ ambulance. The maximum time taken by such patients to reach NICVD was upto 280 minutes. Pre-hospital factors alone were responsible for delayed PCI in 17.9% of patients. When assessed in combination with the hospital-related factors, the pre-hospital factors caused a delay in 70% of cases.

Misinterpretation of signs and symptoms of MI by the patient/ family is common due to reason that knowledge regarding cardiac disease is not very high. Because the chest pain caused by the MI mimics that of gastric acidity most people misinterpret it until there is much delay.^{14,15}

Even many physicians at the primary care level do this mistake and endanger the lives of their patients. Many deaths due to MI go unnoticed because of these deficiencies. An education campaign is a need during the hour which will increase the knowledge of both public as well as physicians at the primary care level and modifies their attitude toward the sign and symptoms of myocardial infarction. The patients reaching directly to the PCI-capable hospital have lesser D2B delays as compared to those who were referred by primary care physicians. This was confirmed by a study by Blankenship et al⁸ reported that 73% of patients who presented directly to the PCI capable hospital there was no D2B delay compared to the remaining 27% of patients who initially presented at a non PCI hospital and later transferred the PCI hospital median D2B time was delayed ($p < 0.0001$).

Hospital related was also evaluated in the current study. Different responsible factors assessed were delay in decision/ consent by the attendant (61.9%), procedure (PCI) related delay (20%), diagnosis-related delay (14.1%), and delay due to readiness of Catheterization lab (10%). Lack of education and knowledge regarding cardiovascular disease, the available treatment options, and their outcome among the general population is a reason for the delay in providing consent for the procedure. In a study, Blankenship et al⁸ found that 17% of attendants of acute STEMI patients caused a D2B delay by providing the consent late. This proportion is quite lower than that found in the current study and thought to be due to differences in literacy rate among the two populations.

On the other hand, there is an acute dearth of tertiary care hospitals which are capable of primary PCI for acute MI patients in Pakistan generally and Karachi especially. The population of Karachi is more than 200 million according to some estimates with only a few public sectors and private sector hospitals with PCI facilities. Because of the expensiveness of this procedure, all lower and middle socioeconomic status patients and some of higher socioeconomic status patients rush to the public sector hospitals. This puts a great burden on these hospitals and the care providers working therein. A limited number of care providers and catheterization labs cause a delay in executing primary PCI on some of these patients. Accordingly, this study also found that these (hospital-related) factors caused a D2B delay in 10-20% of patients with primary PCI. Other studies from other countries found only a negligible amount of cases where hospital-related factors contributed to the D2B delay.^{12,13}

Other factors which Blankenship et al⁸ found associated with delays to reperfusion included diabetes mellitus (38%), previous history of angina and congestive heart failure (37%), female gender (45%), and respiratory failure (30%). The interval from catheterization laboratory arrival to first balloon inflation was similar for transferred and non-transferred patients. Further, it was described that hospital-related delay factors like delay in diagnosis (14%), decision-making delay by the attendant (17%), delay in availability of cardiologist (14%), and delay in readiness of Cathlab comprised 48% of delayed Primary PCIs in the patient of Acute MI.

The current study was the first of its kind in Pakistan. Despite certain limitations like descriptive study design,

smaller sample size, and potential recall biases; the current study has explored a very sensitive aspect of management of acute STEMI in our setup. That aspect is time delays caused by various factors which strongly affect the effectiveness of primary PCI. Along with this the study also puts light on the need of increasing the PCI enable hospitals, their staff, and effective and rapid mechanism of transporting patients with myocardial infarction to the PCI enabled hospitals. Besides education of primary care physicians and the general population is also mandatory. Overall findings have policy implications for strategies aimed at improving timely access to primary PCI.

CONCLUSION

Primary PCI is a very useful and more effective therapy than fibrinolysis for patients of acute STEMI if performed within the suggested time of onset of symptoms. Factors that cause Door to balloon delay decrease the overall efficiency of PCI. Pre-hospital factors (misinterpretation by the patients and first medical contact person and transportation delay) are the major factor that causes D2B delay. Other contributing factors are hospital-related i.e. delay in providing consent by the attendant/consent-related delay, delay in diagnosis, unavailability of a consultant cardiologist, delay in readiness of catheterization lab, and procedure-related delays. Overall there is a need to increase the knowledge and awareness among the general public and general physicians regarding identification and diagnosis of myocardial infarction as well as the increase in PCI enable hospitals and their staff is need of the hour.

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